

"Glacier Dynamics and Changes in Ice Flow"

Guest Scientist:

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Earth2Class

21 April 2012

Where is Greenland?



<http://www.worldatlas.com/webimage/countrys/namerica/gl.htm>

- Part of Denmark
- Home Rule in 1979
- Self Rule as of 2009
- Greenlandic official language



Brief History of Greenland

- Waves of immigration from Canada beginning 4 – 5,000 years ago
- Most of population descended from Thule culture (9th century AD)
- Erick the Red and Norse Vikings arrived in 982 (Norse sagas)
- Norse settlers disappeared around 1450; no known reasons, but much speculation
- Whalers traded with Inuits (glass beads in native costumes)
- Missionary (1721) converted Inuits to Lutherans

Ya knew this was comin'!



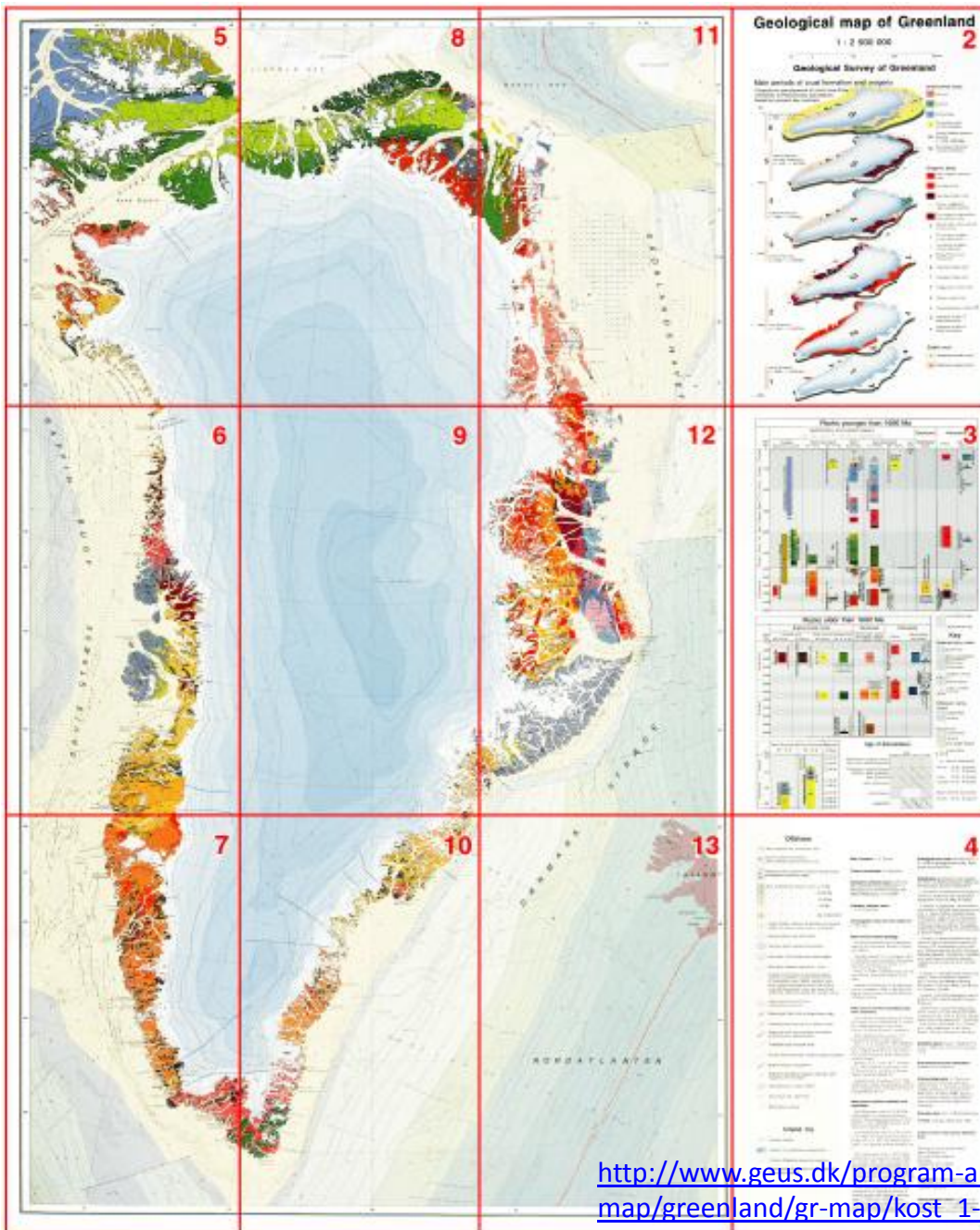
East Greenland - An iceberg mushroom



Icebergs in East Greenland

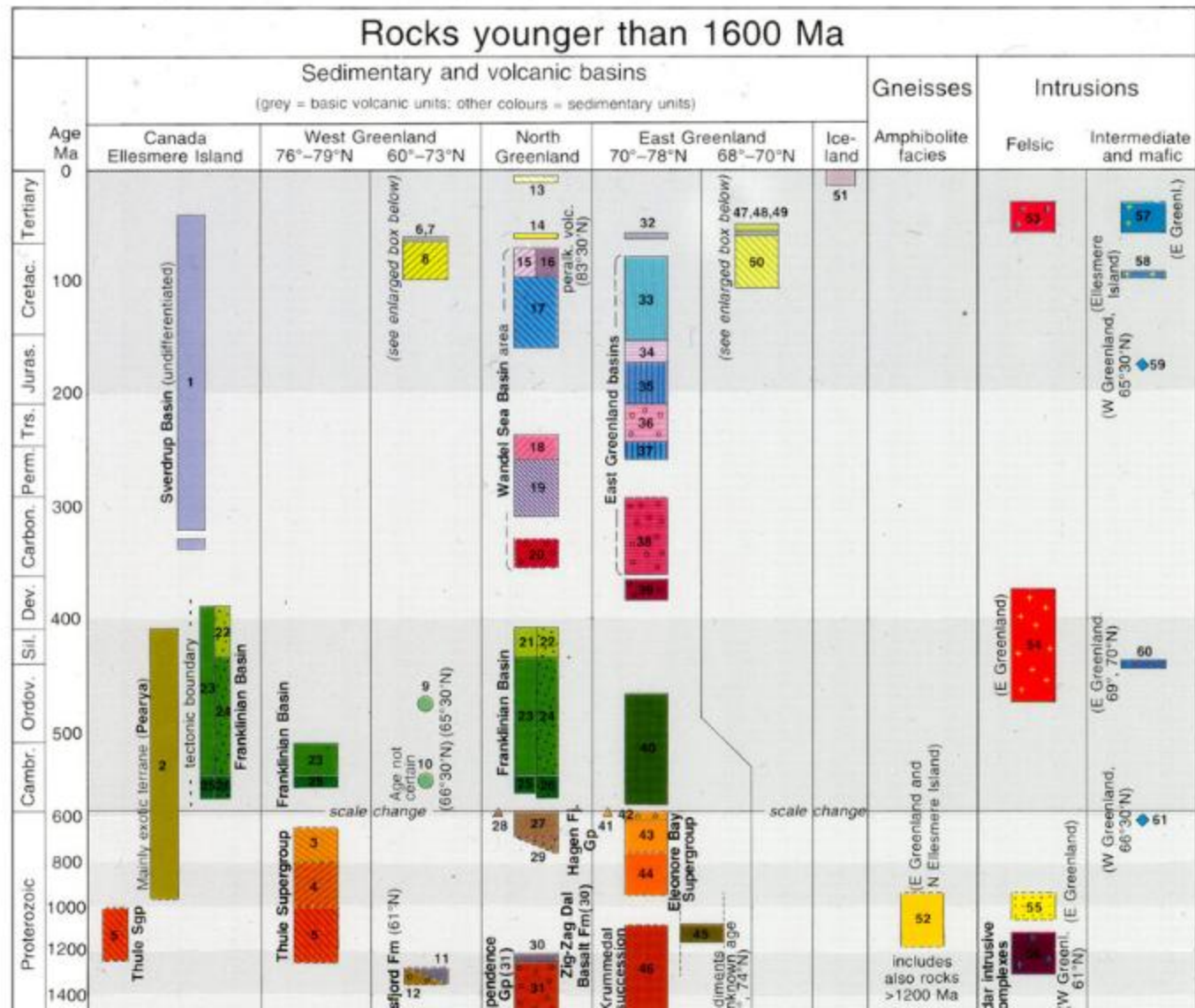
“Tradition and Renewal”

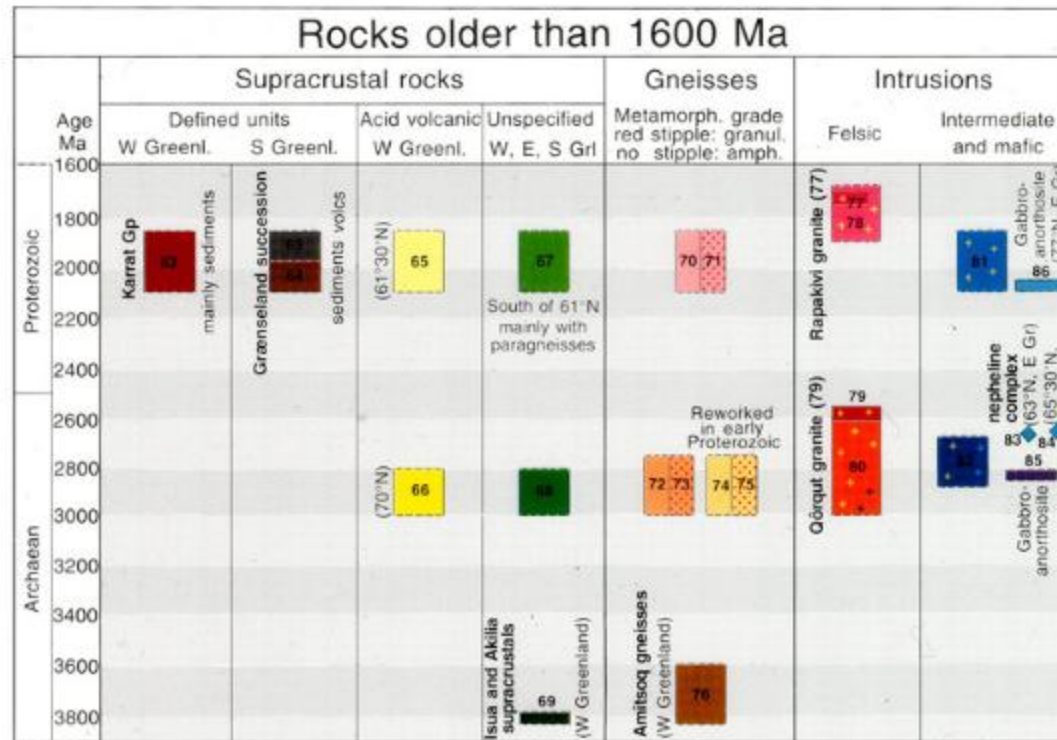
- quajaq (Greenland sea kayak) and ulo (knife) enabled Inuits to survive for centuries in harsh conditions by and from the sea
- dogsleds are traditional transportation
- Modern Greenland, however, depends also on snowmobiles, and cell phones and Internet have become ubiquitous
- <http://www.greenland.com/en/>



Geologic
map
created
by GEUS/
Geologic
Survey of
Denmark &
Greenland

http://www.geus.dk/program-areas/raw-materials-greenland/map/greenland/gr-map/kost_1-uk.htm





Key

well defined age

approximate age

Sedimentary rocks

- Quaternary
- Mainly shelf/deltaic (no overprint)
- Deep-water
- Continental
- Isolated outcrop
- 9, 10, GISP 2
- Glacial (tillite)
- Tillite, isolated outcrop

Intrusive rocks

Alkaline

- undeformed
- foliated

Non-alkaline

- undeformed
- foliated
- with augen texture
- Carbonatite

59, 61, 84

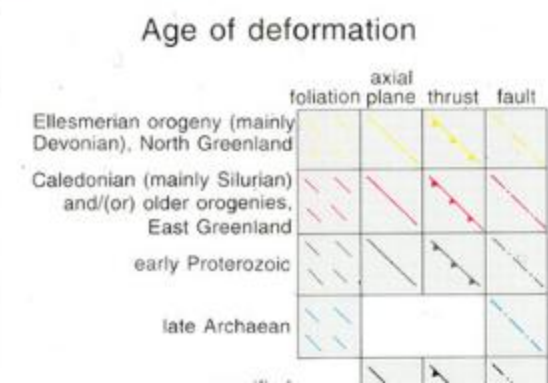
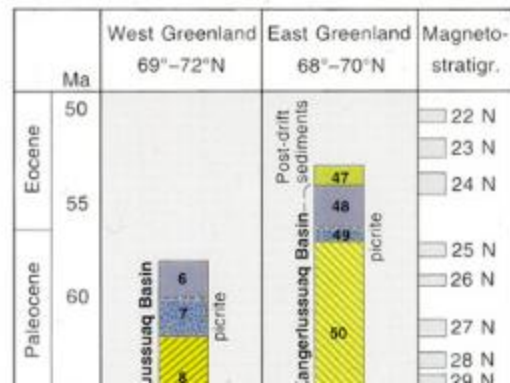
⚠ Mines, abandoned:

Pb+Zn: 72°N, E Greenl.
71°N, W Greenl.

Coal: 70°N, W Greenl.

Cryolite: 61°N, W Greenl.

Major mineral occurrence:
Pb+Zn: 83°N, N Greenl.





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Geological History of Greenland - Four billion years of earth evolution

GEOLOGICAL SURVEY OF DENMARK AND GREENLAND

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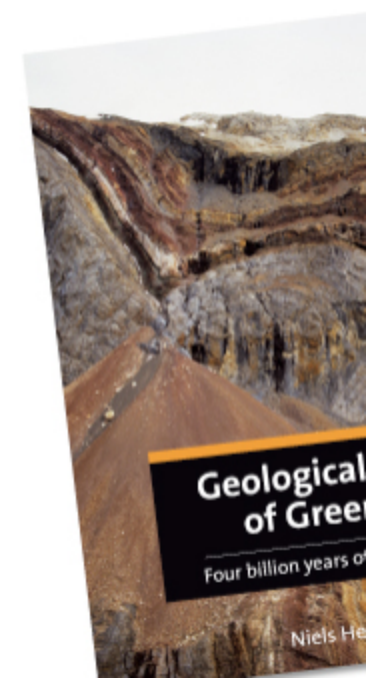
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Geological Survey of Denmark and Greenland (GEUS)

Øster Voldgade 10

1350 København K

Denmark



Geology of Greenland, in brief

- Spans 4 Ga from earliest Archaean to Quaternary
- Largest island in world (2,166,000 sq km), but only c. 410,000 sq km are exposed bedrock
- Inland ice cap reaching over 3 km covers vast majority of the island
- Offshore shelf areas include c. 825,000 sq km

Rocks of Greenland

- Precambrian shield crystalline rocks dominant
- Formed during Archaean and early Proterozoic orogenic events, as part of Laurentian shield



Photo by Jo Roach

<http://www.flickr.com/photos/the-open-university/5616036461/sizes/z/in/photostream/>

Shield consists of

3 distinct basement provinces:

- Archaean rocks (3100 – 2600 Ma), almost unaffected by later orogenic activity
- Archaean terranes reworked during early Proterozoic (1850 Ma)
- Terranes mainly composed of early Proterozoic rocks (2000 – 1750 Ma)

Oldest known oceanic crust 3.8 Ga?



- National Geographic News (Mar 22, 2007)

<http://news.nationalgeographic.com/news/2007/03/070322-oldest-crust.html>

After 1600 Ma, geologic developments was mostly along margins of Shield

- Later Proterozoic & Phanerozoic –
sedimentary basins in North and Northeast
Greenland; 10 – 15 km thick
- Paleozoic orogenic belts (Ellesmerian fold belt
in North Greenland, East Greenland
Caledonides)

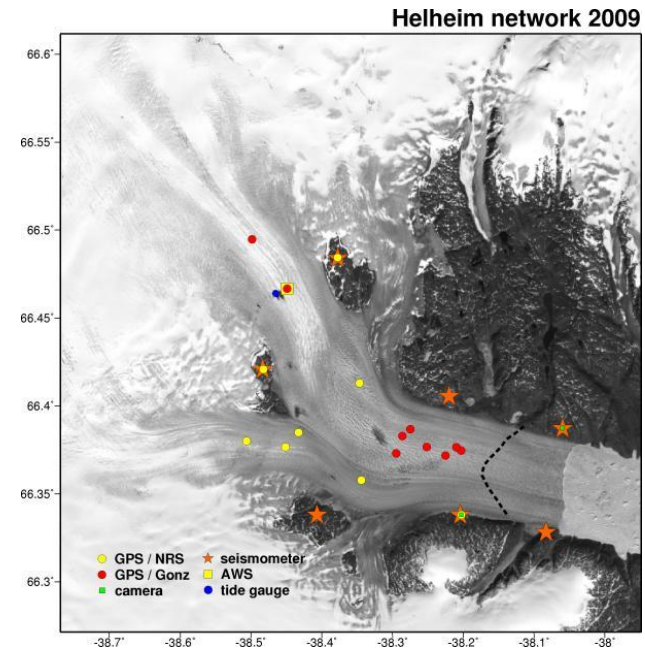
- Upper Paleozoic & Mesozoic sedimentary basins in North, West, and East Greenland, both onshore and offshore
- Continental break-up and formation of rift basins—opening of North Atlantic Ocean
- Extrusion of Tertiary plateau basalts in central West and East Greenland



Quaternary Ice

- Almost completely covered by ice sheets during Quaternary
- Present Inland Ice relic of Pleistocene ice ages
- Vast amounts of glacially eroded detritus deposited on coastal shelves

Studies of Earthquakes and Rapid Motions of Ice (Project SERMI): An investigation of glacial earthquakes and glacier dynamics



<http://www.ldeo.columbia.edu/~nettlers/projects/glaciers/Sermi/>

Project Sermi

- International, interdisciplinary collaboration to understand dynamics of large outlet glaciers on glacier earthquakes
- 90% in Greenland
- Focuses on East Greenland's Helheim and Kangerdlugssuaq glaciers
- State-of-the-art data collection through geodetic, geophysical, and seismic techniques